

## PRECAUTIONS TAKEN FOR STEEL WORKERS

Illinois Steel Co. Perhaps the Pioneer in Accident Prevention.

### U. S. STEEL CO.'S CAMPAIGN

Descriptions of Some Appliances That Effectively Guard Life and Limb in the Mills.

The care exercised by the workman largely enters into the number of accidents occurring in any department, and the only way the number of accidents due to carelessness can be reduced is by the inculcation of habits of caution into the minds of the men, says Robert M. Young in the *Iron Age*. The burden of doing this must rest almost entirely upon the management of a department. The superintendent's attitude and the foreman's attitude toward the prevention of accidents will be reflected by the workmen just as accurately as their attitude toward the getting out of tonnage is reflected. If the superintendent treats the matter lightly, his assistants will treat it lightly. If he shows a strenuous desire to have working conditions safe and precautionary rules observed, if he makes the prevention of accidents one of the most important features of his department, then his foremen will reflect that feeling and will see that the men observe the precautions which are known to be necessary to the prevention of accidents. By seeing that the men observe these precautions and by talking with them about the necessity of keeping conditions safe, they will inculcate such habits of caution that the number of accidents occurring in that department will be reduced to a minimum.

Among the steel companies, the one which has probably been the pioneer in accident prevention is the Illinois Steel Company. For a number of years the subsidiary companies of the United States Steel Corporation have been carrying on a campaign for the safeguarding of machinery and other dangerous places. In the month of May, 1906, Charles MacVeagh, general solicitor of the corporation, called a meeting of the casualty managers of the subsidiary companies to be held at his office for the purpose of considering ways and means of preventing accidents and making working conditions safer. Two days were devoted to the discussion. In May, 1908, Mr. MacVeagh again called a meeting of the casualty managers for the purpose of considering the results of the attempts which had already been made to prevent accidents and to consider and formulate further plans for the safeguarding of employees.

A COMMITTEE OF SAFETY. One of the results of this meeting was the appointment of a committee of safety. Inasmuch as this was, as far as I know, an entirely new thought, it may be well to give a short description of the work of this committee. The committee is composed of the general solicitor of the company, Mr. MacVeagh, who acts as chairman; a safety engineer having general supervision over safety matters in the corporation; C. L. Close, who acts as secretary, and seven members, each one being a representative of some one or more of the subsidiary companies of the concern and engaged in safety work. This committee meets quarterly and its functions are as follows:

The committee conducts thorough inspections of all plants of all subsidiary companies from the standpoint of safety. These inspections are in addition to those made by the companies themselves and are conducted by inspectors selected from companies other than those operating the plants in question. These inspectors report and are responsible to the safety committee and not to the companies whose plants are under inspection. From time to time and whenever special circumstances seem to require such action the committee or various members thereof make these inspections themselves.

The committee acts as a clearing house for all information relating to the safety of employees. All safety devices and other methods of increasing the safety of the workmen and of interesting the men in their own safety and that of their fellow workmen are reported to the committee by the subsidiary companies in which they originate. These safety methods and devices are carefully considered by the committee and if approved are recommended to all the subsidiary companies, often with improvements

places; the promulgation of rules for safe operation, and the inculcation of habits of caution in the minds of all concerned. It might be said in this connection that although statistics show that failure to guard dangerous places is not the most prolific source of accidents, carelessness in this regard has a most marked effect, consciously or unconsciously, upon our thoughts and actions and is therefore conducive to reckless habits. What folly it would be to try to enforce rules or train the workmen into thinking of their own

rail walks. Men are not allowed to go on the bustle pipes or anywhere above the furnace floor without permission from the foreman in charge of the furnace. He stations another man to watch this man while he is above to guard against the dangers from gas. The mud gun, which is used in stopping the tapping hole of the furnace, is equipped with a funnel shaped casting to prevent the men attempting to kick the mud which collects on the cylinder into the hole, thereby endangering the catching of

the men steel guards have been placed with holes through which the bar used in knocking out the props is inserted. Prior to the installation of these guards a man working on the night shift had lain down back of these cupolas and was not seen by the men dumping them. He was so seriously burned by the flames that he died. When the cupolas are relined there is danger of loose brick falling from the stack on the men. To prevent this a screen is put in at the top of the cupola so that should a loose brick fall the screen will catch it. The tops of dolomite cupolas frequently are covered only by the I beams upon which the tub rests when it is dumped. It is important that cast grates that entirely cover the top of the cupola, except where the tub is dumped, be installed, making it impossible for a man to slip and fall into the cupola. It is also essential that the platform at the top of these cupolas, which is about thirty feet above the ground, be equipped with a railing and a high guard at the base of the railing to prevent material being knocked off on men below.

#### GUARDING MEN IN THE ROLLING MILL.

In the electrically operated mill room guards are placed over the driving shafts. These guards are so constructed that they can be lifted off. In the rolling mills guards are placed over all shafting and gears. Where the tables are low the guards are so constructed that they cover the table shafting and the sprocket wheels and the shafting on the floor, at the same time giving easy access to the top of the tables. The sides of the roller tables are guarded by hinged plates. Subways or viaducts are provided where passageway across a mill is required. This does away with the temptation of climbing over the tables instead of going around, thereby endangering the workmen being struck by the hot steel moving on the tables. The subways are roofed with plate to prevent hot scale from the steel falling into them, and all shafting passing through the subway is enclosed.

Guards cover the gears and flywheels of the bloom shears in a roll mill. These gears are entirely encased and little doors are provided in the guards for inspecting and oiling. To protect a workman standing back of a mill roll, while operating a table, from scale, which flies from the steel as it passes through the rolls, glass shields are installed through which he looks as he operates the levers. A series of guards for different parts of machinery is shown at the canbering machine. First, is a guard over the coupling of a motor shaft; then a steel guard enclosing the gears; a plate guard enclosing the spindle or shaft and a plate guard over the coupling boxes which are, in reality, two shafts. These guards are so constructed that they may be lifted off. One of the most important rules that we have is that all levers controlling the operation of machinery shall be so constructed that they may be locked when on center, making it impossible for the power to be turned on accidentally. Workmen are required to attach a warning tag to this lever before working on the machinery. This style of lock requires the use of both hands as the lever cannot be moved without depressing the spring and turning the locking device down.

At machinists' headquarters and at

plate shield is used in a situation of this kind to guard the sprockets and chains, as well as the table shafting and gears. All belts and pulleys are guarded to a height of at least five feet. The apparatus shown drives the live rollers in the finishing department of a roll mill. An economical and simple way of guarding shafting is by using a guard consisting of a steel plate bent into a triangle or inverted U and attached to the bearings and gear guards. In sheet mills, where the plates are partially straightened by pressure applied by means of worn gears, cast guards are placed over the works. A raised platform is installed on a roll housing to provide for the safety of the man working on top of the rolls.

#### GUARDS ON MACHINERY.

In the plants of the American Steel and Wire Company, automatic stops are provided at the wire drawing blocks. The rod or wire which is being drawn is carried through the eye of the lever connected with the motive power, so that a snag in the wire will throw this lever forward and stop the block. In addition to this safety device a rope is attached to the lever, carried over the sheaves above the frame and down at the right hand side of the block, so that if a man should be caught and drawn around the block he would strike this rope and stop the block automatically. We feel that it is necessary to encase gears of lathes entirely, as the danger of being caught between the end of the guard and the cog of a gear, where only partial covering is used, is almost as great as being caught in the gears themselves. It is necessary that the feed gears of a lathe be so guarded that the shield may be easily removed for changing the speed, etc. All of these shields are so constructed that they can be swung back out of the way.

In order to guard the belt on a cone pulley it was found necessary to devise a shifter which could be worked through the guard. Mr. Kille, a member of one of our mechanical safety committees, has invented such a shifting device. It is not only a perfect safety device, but it has been found that it increases the speed of operation. This shifter is so constructed that it is impossible to run the belt off the end of the cone.

There is danger of having a limb caught and sheared off between the table and ribs of a planer bed. A plate guard placed over the bed eliminates this danger. When the beds are left open they are used frequently as a receptacle for tools, oil cans, etc. It is only a short time ago that I noted a newspaper report of an accident where a workman slipped and his head was caught between the table and frame, killing him. Recently a workman had his arm caught in the table trying to get oil out of an oil well in a planer to cut grease on his hands. To prevent a similar accident we have placed plate shields over these oil wells. It has not been customary to place guards over the feed gears of a planer. Investigation showed, however, that men have lost the ends of fingers in these gears by attempting to adjust them while keeping their eyes on the job on the planer. Such guards, therefore, have been installed on all planers. The workmen at first objected to these guards, as they thought they were unnecessary and a nuisance. They have been in use for some time now and the men raise no further objection to them and are, in fact, becoming enthusiastic as the mechanical safety committee in devising new ways to prevent accidents.

In some work, such as facing the under side of a cut, it is not practicable to use

of this kind breaking. An accompanying view shows a guard over a nest of gears driving a bevel gear; another, a method of guarding the gears of a bending machine. Another shows the guards over a double shear flywheel and gears. The guards over a vertical punch are shown in another of the illustrations.

In the roll press all gears on the lathes are so guarded that it is impossible to come in contact with them. The standard requirement for gear guards is that the gears shall be covered on the sides as well as on the face, and that the gears shall cover the gears to such an extent that the danger of being caught between the end of the guard and a cog of the wheel will be eliminated.

Band saws have a hinged guard covering the top and front of the saw to prevent the saw flying should it break, and a head guard extending down the front of the saw to prevent the workman's head accidentally coming into contact with the saw. The saw below the table is encased. There has been a great deal of difficulty in finding circular saw guards that were practical, where many thicknesses of wood were sawed. Mr. Roberts, a member of one of our mechanical safety committees, has invented a guard which, because of its form, is all right. It may be because the foreman devised the guard. A different style of circular saw guard has been devised by Mr. Walker, a foreman of the Tennessee Coal, Iron and Railroad Company. It consists of a hinged arm extending over and covering the saw and supported by a wheel resting on the saw table. The size of the wheel depends on the thickness of the wood sawed. For instance, a saw cutting up to 3 inch material would have a guard wheel of from 7 to 8 inches in diameter. Mr. Orutt, of the National Tube Company, has devised a guard which in addition to guarding the saw is used to shove the last end of the piece through the saw, which is a very important provision.

We feel that the belts and pulleys in the carpenter shop should be so guarded that there will be no danger of timber being caught in them. They are currently enclosed in steel casings. It is important that the knives of a wood joiner be guarded. We have used a guard over these knives for a number of years which we have found to be satisfactory, since it has been equipped with a strong spring to draw the guard back. However, one of the best safety devices for these machines is a safety cylinder which instead of pulling the man's hand into the knives thrusts it out of the machine, and instead of losing his fingers or hand he is merely scratched or slightly cuts. We had an actual demonstration of the efficiency of this style of cylinder recently. The workman was planing a short piece when it slipped and his hand went into the machine. Instead of being seriously hurt he received only a slight cut and after having it dressed returned to work. A wood joiner so equipped is here shown.

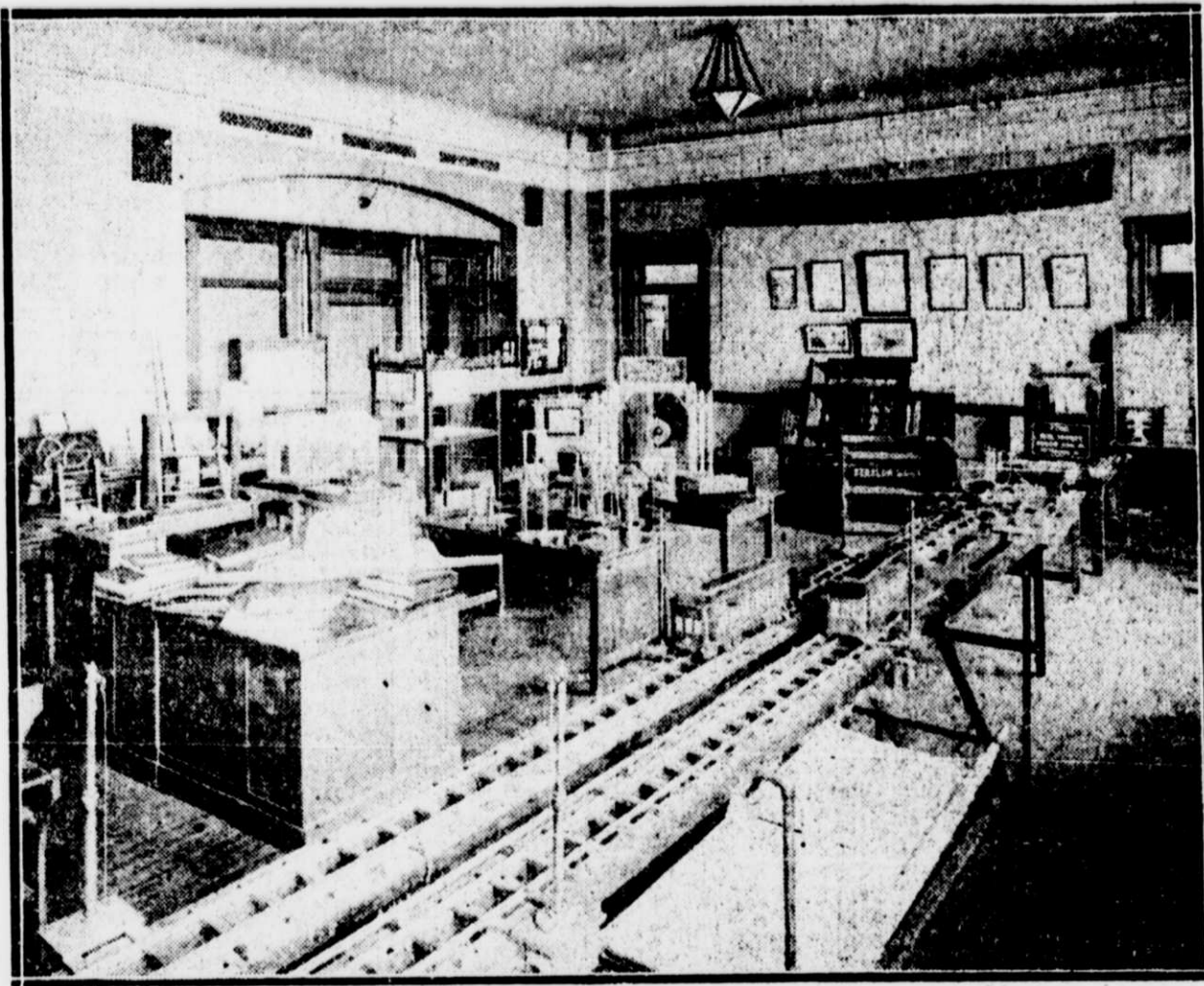
#### GOOGLES IN CHIPPING YARDS.

It is compulsory that men ragging rolls wear masks to protect their eyes and face. In the past, however, an accident occurred in which a man was killed by a pair of goggles free of charge and urged to wear them. Every morning the foreman makes sure that each man has a perfect pair of goggles and calls his attention to the necessity of wearing them. Most of the men do wear them on their hats. Another instance of a safety device that saved an accident. A man was pouring babbit when it exploded. Had he not been wearing the eye shields he would have lost the sight of both eyes. In the foundry, the large receptacles or mixers which retain the metal before it is poured is provided with a plate fence instead of railings around the platform to prevent the crane hooks from catching. The levers controlling the operation of the mixer are guarded with plate shields for the same purpose. The brass converter of the foundry is provided with a plate shield. I would call attention to the necessity of a locking device being attached to the wheel used in tipping this converter, as when heavy with skull it will tip over if not locked. We have had an actual demonstration of this.

A large percentage of accidents occur in a foundry from feet being burned by slopping metal. It is very important that the workmen wear whole shoes and that they be so constructed that they may be slipped off quickly. We urge upon the workmen the advisability of wearing the so-called congress shoes. Many accidents are prevented by placing a guard on the foundry hand ladders. This consists of a steel shield on the side of the ladder over the handrail. If the workman stumbles and slips the metal shield protects his hand.

The ends of piston rods extending beyond the cylinder heads should be guarded, the purpose of the shields being to prevent a man getting so close to the cylinder that he will be struck by the rod.

In the boiler house a raised walk is placed on each boiler and leads from boiler to boiler. The water gauge glasses should be guarded. A guard devised by the American Steel and Wire Company is a semicircular shield so constructed that it may be turned around, coming between the workman and the glass, while the glass is being tested or heated. It is then turned back of the glass, giving an unobstructed view of the gauge. To assist in seeing the water line there is an electric lamp installed at each water gauge. Each boiler is equipped with a non-return valve so that if a tube bursts or there is some other explosion the valve closes automatically and the steam cannot rush into this boiler from the other boilers. All relief valves are piped through the roof so that steam will not



THE AMERICAN MUSEUM OF SAFETY.

suggested by the committee. In this manner descriptions with full details, photographs, diagrams and complete information of all matters dealing with the safety of employees is disseminated among the subsidiary companies.

The committee, at its quarterly meetings considers all serious accidents which have occurred in any of the companies during the preceding quarter with a view to devising means for preventing the recurrence of similar accidents.

In addition to its work for the prevention of accidents the committee assists in the administration of the voluntary accident relief plan and considers any questions of general character which arise in the administration of the plan.

The committee is endeavoring now to standardize these safety devices which are in use upon machinery common to a large number of the different plants. It is hoped thus to insure the use of only the most improved and effective safeguards. As a further help in familiarizing the superintendents and foremen of the different plants with the safety devices approved by the committee a *Safety Bulletin* is issued periodically, showing engravings of safeguards and working drawings of devices, with a full description of their operation.

#### WORK OF THE ILLINOIS STEEL COMPANY.

It is obvious that the industrial plant which would seriously take up the problem of accident prevention must undertake to provide and maintain proper working conditions and efficient safeguards and to educate its employees and inculcate in them habits of caution. This of course requires a definite plan and a comprehensive organization to carry out such a plan. In handling this work the Illinois Steel Company has divided it into three closely allied headings: The safeguarding of dangerous

and others' safety if we did not show our desire to prevent accidents by doing all in our power to make working conditions as safe as possible!

The Illinois Steel Company operates five plants, each plant covering many acres and employing thousands of men. The plant at South Chicago, for instance, covers about 400 acres and when running full gives employment to about 12,000 men. Across the train yard of this plant has been installed a very important safety device, a viaduct 422 feet long, which we believe saves many lives and limbs annually. Sometimes there is a railroad track between a roadway and a mill; and in that case, where practicable, a viaduct is provided. The roadways throughout the plant are macadamized, and being well defined have a tendency to keep the men from taking dangerous short cuts over tracks.

At all the entrances to the plants of the National Tube Company illuminated signs are displayed, upon which are shown safety precepts. These sermons, which continually remind the men that to a large extent they are their brother's keeper, are painted on glass slides in English and foreign languages and are changed periodically. We have also copied from the National Tube Company the idea of calling to the attention of men asking for employment the stress that is laid upon the prevention of accidents. This is a sign at the employment bureau stating that if men are not willing to be careful of their own and others' safety we do not want them in our employ.

At the docks of the South Chicago plant 3,500,000 tons of iron ore were handled during the season of 1910, and there were no accidents causing the loss of more than two weeks time to any man. There were four men injured during the year, who lost less than two weeks time each. At the docks where iron ore is taken from vessels by machinery all of the unloaders have been thoroughly equipped with ladders, stairs and raised walks, and all gears and shafting have been guarded. At different points along the main roadways of the plants are signs regarding the prevention of accidents, reminding the men of the necessity of being familiar with the safety rules.

#### TRESTLES HAVE WALKS; WALKS HAVE RAILS.

All trestles from which material is handled are equipped with walks. All walks are railed, and at the base of the railings is a guard board to prevent material or tools falling on a person passing below. While there is a driveway or passageway under the trestle it is completely plankled over at that point between the rails and between the tracks. Where there are several tracks on these trestles a walk is provided down the center of the trestle for the use of switchmen and men dumping the cars. Under these trestles are pockets, in which the material is stored. The gears operating the drums forming the bottom of these pockets are covered, and a rope safety line is stretched the entire length of the pockets, which, if pulled, cuts off all power, sets a brake and stops all machinery.

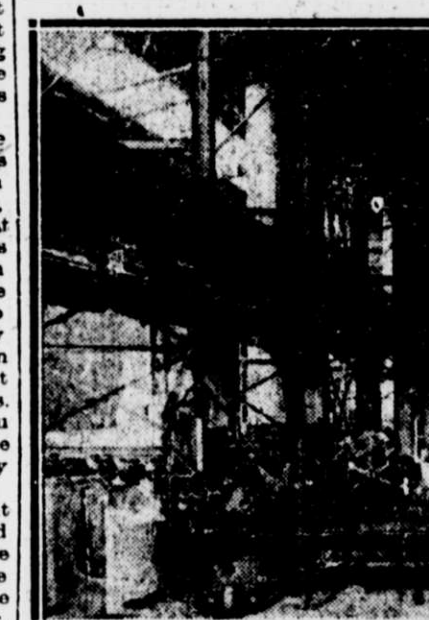
The new, thin shelled, water cooled blast furnace is equipped with a system of stairs and platforms to facilitate safe inspection of the furnace and water cooling apparatus. At blast furnace plants all stoves and furnaces are connected by walks provided with hand railings and guard plates at the base of the railings. Each cast house is equipped with stairs or runways leading away from the furnace, so that in case of a breakout the men can quickly leave the danger zone. All elevated floors are railed; the cast houses are roofed with steel plate to protect the men from material blown out of the top of a furnace; and the side sheeting on the cast houses is brought down so far that storms cannot beat in on the runners. One of the main precautions to be taken in handling hot metal is to keep all utensils dry.

Where ladles are loaded under the floor of a cast house the casting holes are guarded by grates. The whistles in the blowing engine room are operated by a switch placed behind a shield together with the furnace pressure gauge and the short valve lever. When the switch is thrown to blow the whistle—it lights an electric lamp placed above the switch, which shows that the circuit is complete. It also lights a lamp in the blowing engine room showing which furnace is signalling. The shield is for the purpose of protecting the man giving the signal or operating the lever to reduce the pressure should something go wrong with the furnace. All bustle pipes on furnaces are equipped with

their feet by the plunger. Since the installation of these guards some four years ago no accidents have been caused in this way. Prior thereto a workman lost half of one of his feet.

#### SAFETY HELMETS.

It is sometimes necessary to work where there are large quantities of gas and the men are provided with safety helmets, to be used in doing this work or in doing rescue work. Each blast furnace plant and each gas engine plant is equipped with these helmets, and a carefully trained corps of men is always on hand. On all large gaspipes used in blast fur-



OPEN HEARTH FURNACE—CHARGER IN FOREGROUND.

nace plants, or at gas producers, the tops of the pipes are provided with hand ladders to keep men from falling off. The weights on the explosion doors on these pipes are provided with safety chains, so that should the hinges supporting the door break the weight or door cannot fall on men passing below. On the gas washing apparatus has been installed a system of platforms and stairs. At the base of the stairs there is a railing to prevent a person descending the stairs suddenly stepping on the railroad tracks which pass close by these washers. By causing him to walk around the end of the railing his attention is called to the danger from an approaching train.

In the open hearth plants on the side of the building on a level with the overhead electric crane track are built platforms for use in crane repairs. There are three of these platforms along this floor. This does away with the necessity of using swaying scaffolds in repair work.

In order to prevent the stoppers of ladles dropping from the hook as they are lifted from the pouring ladles a special hook has been devised. The point of this hook has been elongated and curled so that the stopper is securely held. When ladles of metal are hoisted by cranes to be poured into mixers it has been customary to attach the hook of the auxiliary hoist (which is used to tip the ladle when pouring) while the ladle is on the ground. There is danger of the auxiliary hoist being raised faster than the main hoist and pouring the ladle while in midair. To overcome this a hook has been devised which the crane operator attaches after the ladle has been raised to the pouring position.

On the pit side of the open hearths, where the steel is poured into moulds and immediately back of the cage of the cranes handling the molten metal, there is an escape platform for the crane man, to be used if there is an explosion of hot metal. This platform extends through the side of the building and is provided with railings and stairs giving the crane man a quick means of egress from the danger zone. In rebuilding an open hearth furnace the furnace and ports are torn down a number of feet below the charging floor, and in order to prevent material being knocked down on the workmen a plank fence is built at the top of the opening. Prior to the installation of this precaution it was not uncommon for a workman to sustain injuries from this source, as poor fellows sustaining a broken back. The doors at the bottom of the cupolas are usually held shut by a steel prop, and in order to drop the cupola when cleaning out refuse these props are knocked out with a long bar. The dropping of the doors is accompanied by sheets of flame, and in order to protect

points where operators congregate are displayed large enamelled steel signs bearing the wording "Never work on a table, crane or other machinery before notifying the operator and attaching a danger tag, bearing your name, at the point where the power is turned on. Get these tags from your foreman." The workman's name is either painted or written on the tag.

A protection is placed over the roller bearings or driving shafts of bar mills. These shafts are about three feet from the floor and the guards are on legs making them light and convenient for handling. The ends of the wabblers on these roll-trains are guarded with steel shields. It has been said that these wabblers—which are, in fact, the ends of the roll necks—are not dangerous, but one

the patent or smooth chuck, but the use of a set screw is necessary. When this is the case the set screw is counter sunk and guarded by a sliding cover. The method of guarding a boring mill is to encase the top and bottom gears, install a plate guard in front of the mill table and place a guard around the counterweight, so that should the cable supporting the weight break the weight cannot fall on any one.

We require that all emery wheels over 8 inches in diameter shall have a safety taper of three-quarters of an inch to the foot and be provided with safety collars. This means that the wheel will be convex in shape, while the collars will be concave, and should the wheel break (split), it being thicker at the hub than at the face, the pieces are held in place. In the American

Steel and Wire Company shop small die grinders are equipped with heads, plate glass shields to protect the workmen's eyes, exhaust systems and shaded electric lamps. This is a model installation. An actual demonstration of the efficiency of this style of wheel was given when a 24 inch wheel, running 6,000 feet per second, split a several feet high wheel which was held by the safety collars.

It is necessary that large grindstones be provided with substantial guards over the stone. It was only a short time ago that I received a newspaper clipping of a fatal accident caused by a grinder

blow off in the building. There are a number of precautions set forth in our boiler house rules, such as numbering boilers, blowoff line relief, stop valves, valves in feed water connections, drains in pockets, etc.

All flywheels are guarded, either with plate or wire net guards. Where the protection is within eighteen inches of the wheel it is five feet high and where it is more than eighteen inches from the wheel it is 3 feet 6 inches high, which is the standard height of all railings. The guard is carried over the bearings of the wheel at



INTERIOR OF BILLET MILL.

instance has come to my attention where a workman's clothing was caught on one and he was killed. At the ends of all loading beds are placed guards which will prevent material falling off, but which can be lowered when the material is loaded in cars. The material is stacked on the beds and there is a possibility of a piece falling off and striking a man walking on the track below. This was brought home very forcibly by the death of a foreman who had been in our employ over twenty years. At sheet mills chain conveyors frequently are used to carry the plates from one table to another. A semi-circular

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